

Manufacturing Tolerances
for
Standard Steel Doors
and Frames



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Manufacturing Tolerances for Standard Steel Doors and Frames

1 Introduction

It is the intent of this publication to provide users of standard steel doors and frames with definitive information regarding manufacturing tolerances. It is also intended to provide installation contractor(s) of the tolerances to be considered to assure proper operation of the complete opening. This document is intended for in-plant inspections. It may be used for on-site inspections where there is no evidence of damage to material or improper installation.

The information contained herein pertains to doors and frames manufactured in accordance with ANSI A250.8, *Recommended Specifications for Standard Steel Doors and Frames*. It is not intended to reference to special or unusual door and frame conditions.

2 Reference Documents:

ANSI/SDI A250.8 *SDI 100 Recommended Specifications for Standard Steel Doors & Frames*

ANSI/SDI A250.6 *Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames*

ANSI/SDI A250.7 *Nomenclature for Standard Steel Doors & Steel Frames*

ANSI/SDI A250.3 *Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors & Frames*

ANSI/SDI A250.10 *Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames*

ANSI/SDI A250.11 *Recommended Erection Instructions for Steel Frames*

ANSI/BHMA A115 *Specifications for Steel Door and Frame Preparation for Hardware (A115.1 – A115.18)*

ASTM A568 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*

ASTM A653 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM A924 *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2007 Edition (National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269; www.nfpa.org)

SDI 122, *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

3 Materials and Finishes

3.1 Steel Thickness

Manufacturers no longer order sheet and coil to a specific gage, but rather to a minimum decimal thickness. This thickness is the lowest of the range for a specific gage. The steel supplier is therefore permitted to exceed, but not be less than the specified decimal thickness. These minimum values meet the stringent requirements of both Underwriters Laboratories Inc. and ITS/Warnock Hersey. Examples of minimum allowable steel thickness:

Gage (MSG)	Minimum
20	0.032"
18	0.042"
16	0.053"
14	0.067"
12	0.093"
10	0.123"
7	0.167"

Gage (MSG) are for reference purposes only.

3.2 Steel Coatings

Thickness of metallic coatings (generally zinc) are defined by ASTM A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. The two most commonly used designations are A40 and A60. Minimum requirements for these designations are:

A40 = 0.40 oz/ft² total both sides.

A60 = 0.60 oz/ft² total both sides.

For reference, 1 oz/ft² = 1.7 mils thickness.

3.3 Factory Applied Coatings

Since factory applied coatings (primer, finish paint, etc.) are subject to performance standards rather than thickness, the dry film thickness is irrelevant. Such coatings must comply with performance criteria of:

ANSI/SDI A250.3 – *Test Procedure and Acceptance Criteria for Factory Applied Finished Painted Steel Surfaces for Steel Doors and Frames*

OR

ANSI/SDI A250.10 – *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*.

4 Frame Tolerances

4.1 Frame Cross Section Profile

Permissible tolerances in frame profile surfaces are as shown below:

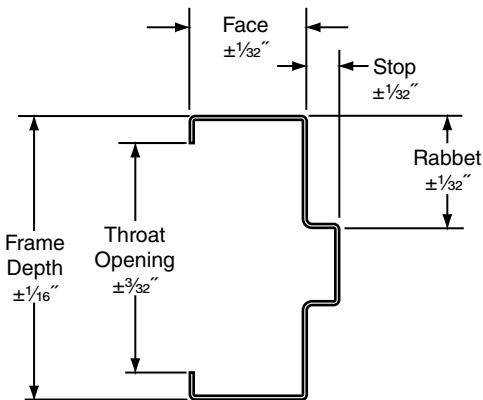


Figure A – Profile Tolerances

4.2 Frame Opening & Vertical Locations

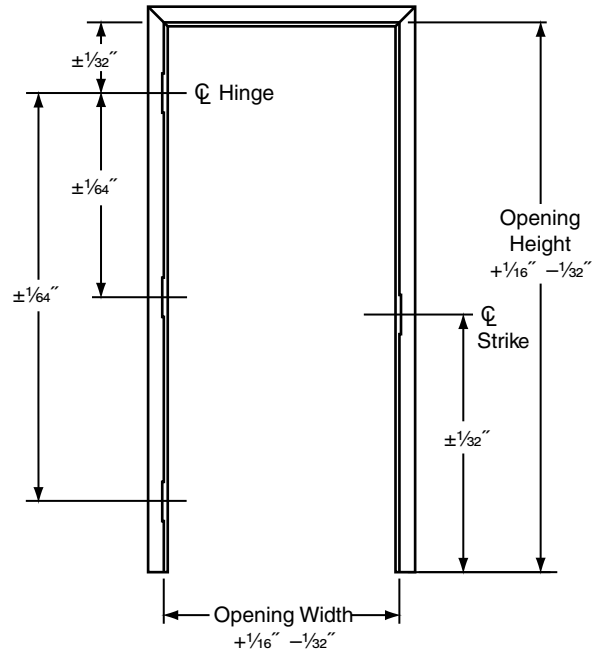


Figure B – Opening Tolerances

4.3 Bow or Twist of Jambs or Header

Realizing that frames are somewhat “pliable”, and require bracing and alignment during installation, allowable deformation (bow, twist, etc.) of jambs or header of frame **prior to installation** shall not result in a reduction of opening sizes more than 1/16” beyond those shown in Figure “B” when measured at any point.

4.4 Horizontal Alignment of Door Within Rabbet

Hinge and strike backsets shall allow the horizontal centerline of the door to be in line with the horizontal centerline of the frame rabbet $\pm 1/32$ " prior to installation. Figure "C" is an example based on a $1\ 3/4$ " door in a $1\ 5/16$ " rabbet.

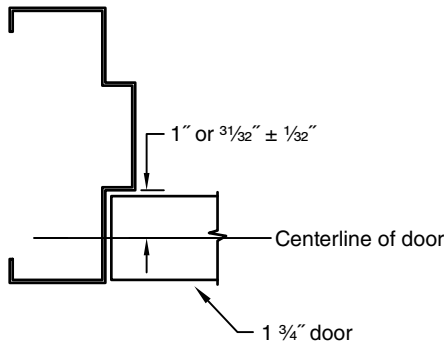


Figure C – Horizontal Alignment

4.5 Frames with Lights or Panels

Opening sizes (width or height) for side or transom lights or panels and for borrowed light frames shall be subject to a tolerance of $\pm 1/16$ " for each individual light or panel. These tolerances shall be non-accumulative so that the overall frame opening sizes are not increased by more than $1/8$ ".

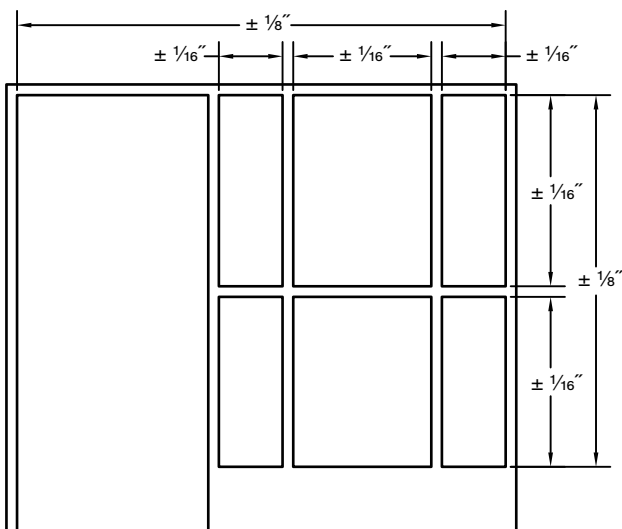


Figure D – Frames with Lights or Panels

5 Door Tolerances

5.1 Door Size, Thickness, and Vertical Locations

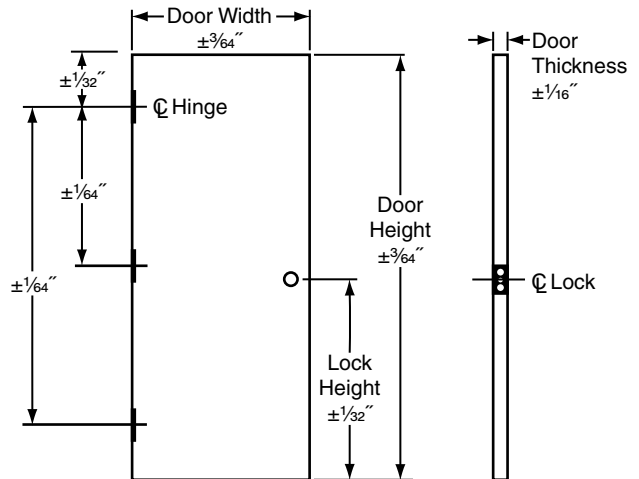


Figure E – Doors

5.2 Door Squareness

When measured diagonally from corner to corner along the same face, the measurements shall be within $1/16$ " of each other.

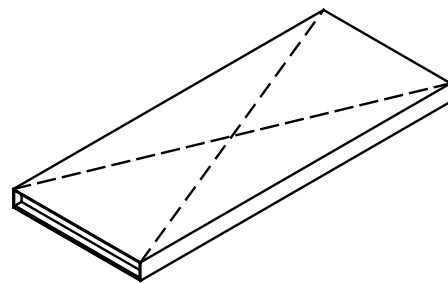


Figure F – Squareness

5.3 Door Perimeter Flatness

When a suitable straightedge is laid against the door face at or within 1/4" of the top, bottom, hinge edge, and lock edge on both faces any deviation between the face and the straightedge shall not allow a 0.0625" rod or block to pass.

Note: The straightedge shall be allowed to "rest" naturally on the door surface, not pulled down at one end to meet the door.

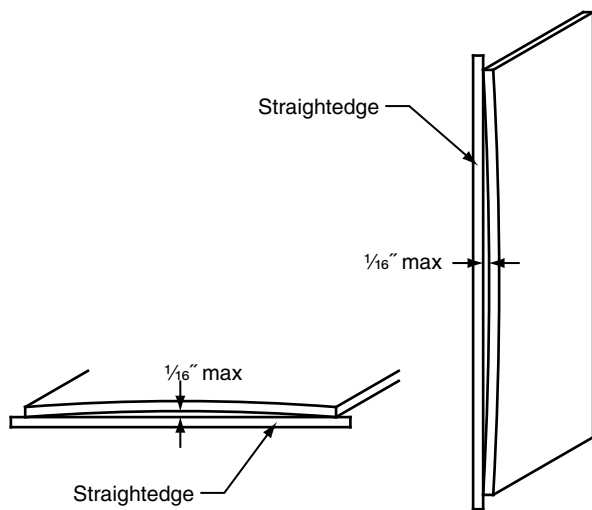


Figure G – Flatness

5.4 Door Face Bow or Crown

When a suitable straightedge is laid diagonally against the door face at least 1/2" from corners any deviation between the face and the straightedge shall not allow a 0.125" rod or block to pass.

Note: The straightedge shall be allowed to "rest" naturally on the door surface, not pulled down at one end to meet the door.

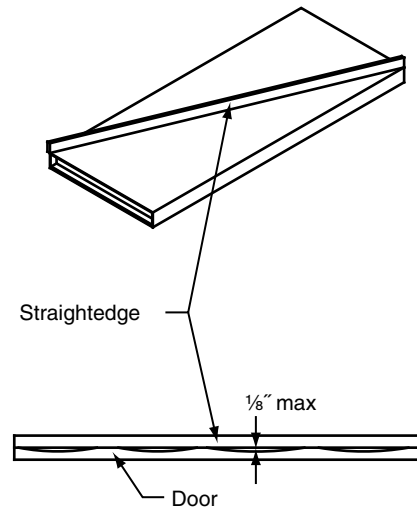


Figure H – Flatness

5.5 Door Twist

The door is laid onto a suitable, flat fixture or surface that is free of any warp, bow, or twist. Support blocks of identical heights shall be inserted between the fixture and the door face at all four corners of the door. Any deviation between the face and the support blocks shall not allow a 0.0625" rod or block to pass.

Note: The door shall be allowed to "rest" naturally on the support blocks, not pulled down at any corner to meet the blocks.

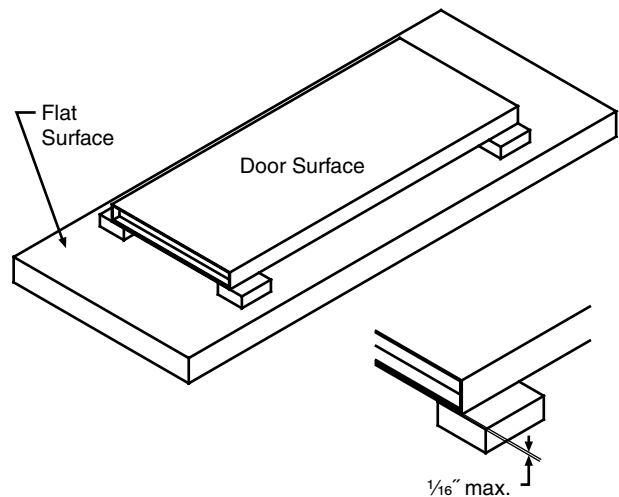


Figure I – Door Twist

5.6 Doors with Lights or Panels

Opening sizes (width or height) for lights or panels cut into doors shall be subject to a tolerance of $\pm 1/16$ " for each individual light or panel.

6 Hardware Preparations

6.1 Vertical Locations

Tolerances for vertical locations are as noted in Paragraphs 4.2 and 5.1.

6.2 Horizontal Alignment

Tolerances for horizontal alignment of door and rabbet are as noted in Paragraph 4.4.

6.3 Mortise Depth

The depth of hardware items mortised into edges of doors (such as hinges, strikes, lock fronts, flushbolts) shall be as defined on manufacturer's templates and/or ANSI A156.115 documents subject to an additional tolerance of $\pm 1/64$ ".

6.3.1 Cutout Depth at Frame or Door Faces

In order to allow for field adjustment, usually accomplished by shimming, hardware cutouts (such as hinges) that extend from door edges around to faces or from frame rabbet around to faces are allowed to exceed mortise depth by $1/16$ ". See Paragraph 7 for examples of common hinge shimming procedures.

6.3.2 Depth for Recessed or Concealed Hardware

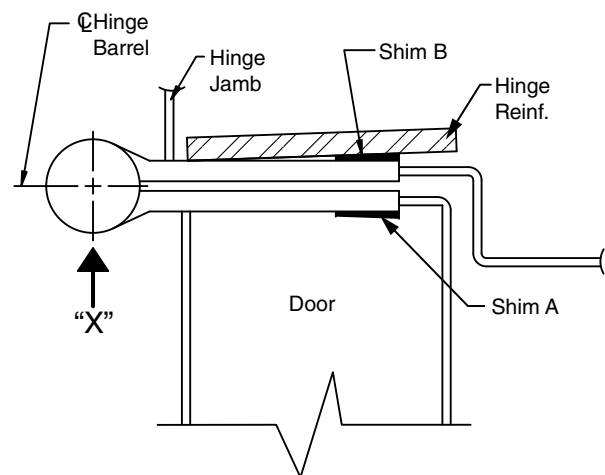
The depth for hardware items recessed into top or bottom of doors or edges of doors (such as pocket pivots, floor closers, top pivots, concealed closers or holders, etc) shall be as defined on manufacturer's templates subject to an additional tolerance of $+1/16$ " -0 ". Notches in door faces shall have similar tolerances.

7 Frame Installation and Door Adjustments

7.1 Adjusting Pivot Point by Shimming

Providing extra depth along door or frame faces allows for hinge knuckles to be offset, thus changing the pivot point of the opening. Shims are usually thin strips of $1/4$ " wide material approximately equal to the hinge height.

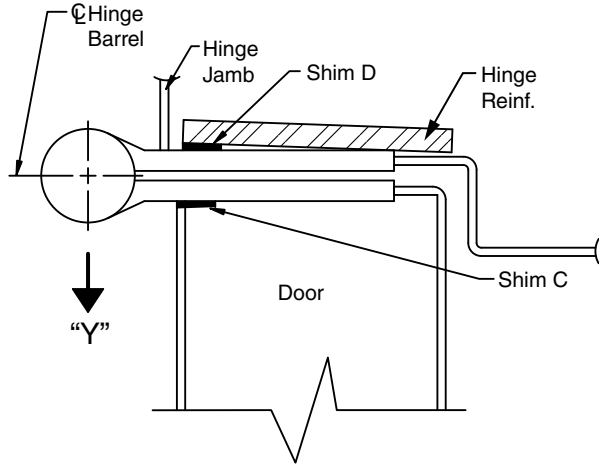
7.1.1 Figure "J" shows how to relocate the pivot point toward the jamb.



- Using shim "A" only, door will be relocated in the direction of arrow "X".
- Using shim "B" only, will move both door and centerline of hinge barrel in direction of Arrow "X".
- Using both shims "A" and "B" will relocate the door in direction of Arrow "E" by a greater amount than by using shim "B" alone.

Figure J – Hinge Bind, Shims A and B

7.1.2 Figure "K" shows how to relocate the pivot point away from the jamb.



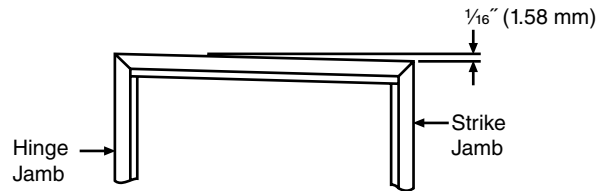
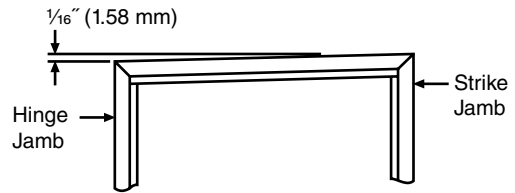
- Using shim "C" only, door will be relocated in direction of Arrow "Y".
- Using "D" only, both door and centerline of hinge barrel will move in the direction of Arrow "F".
- Using both shims "C" and "D" will relocate the door in direction of Arrow "F" by a greater amount than by using either "C" or "D" alone. The centerline of hinge barrel will be relocated the same as by using shim "D" alone.

Figure K – Hinge Bind, Shims C and D

7.2 Frame Installation Tolerances

While this document is mainly concerned with tolerances relating to the manufacturing process, openings will not function properly if the frame is not installed within recognized tolerances.

Figures "L-M-N-O" show examples of the accuracy to be maintained while setting frames. Instructions for installation may be found in ANSI A250.11.



Maximum 1/16" allowable tolerance on total opening.

Figure L – Squareness

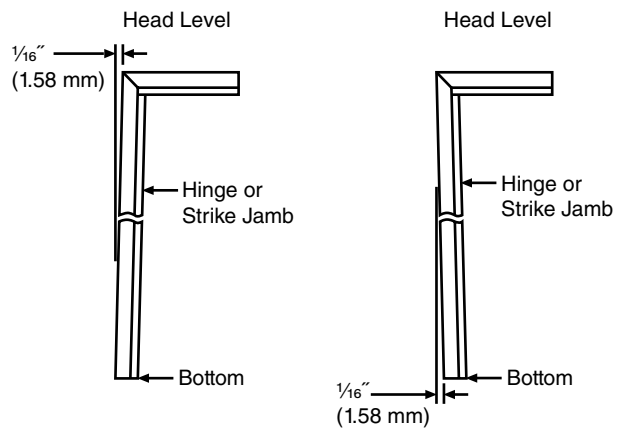


Figure M – Plumbness

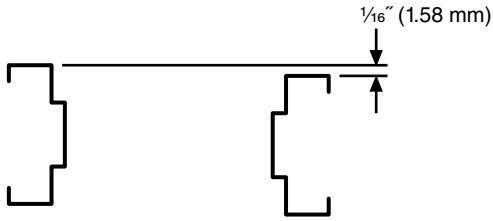


Figure N – Alignment

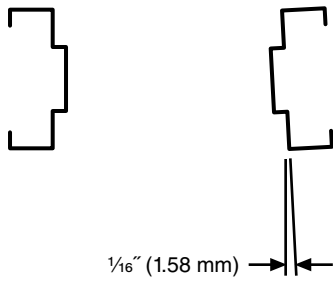


Figure O – Twist

7.3 Troubleshooting

Further information regarding corrective actions for door & frame openings may be found in SDI-122.

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AVAILABLE PUBLICATIONS

Specifications

- ANSI/SDI A250.6** Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames
- ANSI/SDI A250.8** SDI 100 Specifications for Standard Steel Doors & Frames
- SDI-108** Recommended Selection & Usage Guide for Standard Steel Doors
- SDI-118** Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements
- SDI-128** Guidelines for Acoustical Performance of Standard Steel Doors & Frames
- SDI-129** Hinge & Strike Spacing

Test Procedures

- ANSI/SDI A250.3** Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors & Frames
- ANSI/SDI A250.4** Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
- ANSI/SDI A250.10** Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames
- ANSI/SDI A250.13** Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)
- SDI-113** Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door & Frame Assemblies
- SDI-131** Accelerated Physical Endurance Test Procedure for Steel Doors, Frames and Frame Anchors

Construction Details

- ANSI/SDI A250.11** Recommended Erection Instructions for Steel Frames
- SDI-110** Standard Steel Doors & Frames for Modular Masonry Construction
- SDI-111** Recommended Details for Standard Details Steel Doors, Frames, Accessories and Related Components
- SDI-122** Installation Troubleshooting Guide for Standard Steel Doors & Frames

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors & Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors & Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electrified Hinge Preparations
- SDI-134** Nomenclature for Standard Steel Doors & Steel Frames

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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